**Bonneville Power Administration**

***THE BRIGHT WAY TO HEAT WATER™***

# GENERAL AND TECHNICAL SPECIFICATIONS for SOLAR POOL HEATING SYSTEMS

## 1. GENERAL PROGRAM SPECIFICATIONS

1.1. The solar pool heater (SPH) must be installed at a residence with electric service provided by [UTILITY NAME].

1.2. The participating customer must be the owner of the property or the owner's legally assigned representative.

1.3. The swimming pool must be electrically heated.

1.4. Only solar pool heaters determined eligible by BONNEVILLE qualify for the Program. Owner-built systems do not qualify. Additions to existing systems may qualify with [Utility Name] prior approval, and providing the entire system meets the general and technical specifications for solar pool heating systems.

1.5 The eligible solar pool heater must be purchased from a contractor-determined eligible by [UTILITY NAME] to participate in the program.

1.6. An eligible solar pool heating system must be purchased on or after April 15, 1999, to qualify.

1.7. The installed SPH must be inspected by an [UTILITY NAME] representative to determine compliance with all program requirements.

## 2. GENERAL EQUIPMENT SPECIFICATIONS

2.1 Solar collectors must be certified by the Florida Solar Energy Center.

2.2. Equipment and systems must undergo a technical review by BONNEVILLE to be determined eligible for the Program.

2.3. Solar pool heating collectors shall be of the copolymer plastic type and carry a minimum 10-year full warranty.

2.4. Eligible solar pool heating systems will incorporate freeze protection strategies that shall possess demonstrated or theoretical reliability in weather conditions common to the BONNEVILLE service territory.

2.5. Equipment and installation shall comply with all applicable building, plumbing, and electrical codes. If applicable, building permits shall be procured.

2.6. All equipment and materials used in this program shall be installed according to manufacturers' specifications, those included in this document, SRCC OG-400 Standards and any others required by BONNEVILLE. BONNEVILLE reserves the right to require compliance with installation specifications that may exceed or differ from those of a manufacturer.

## 3. INSTALLATION SPECIFICATIONS

### A. Consumer Documents

1. *When applicable, customer has received building permit for the system installation.*

   Contractor shall secure all Building Permits required by law for the installation of a solar pool heating system and arrange or have the customer arrange for all required permit inspections.

2. *Customer has received contractor's installation and manufacturer's component warranties.*

   Contractor shall provide customer with a written warranty stating the equipment and installation will be free from all defects in workmanship and materials for at least two years from the date of final approval by [UTILITY NAME]. Warranty shall include all labor for any repairs within the warranty period. Manufacturer's component and material warranties shall be supplied to customer and may be used to satisfy part of this warranty requirement.

3. *Customer has received an owner's manual and complete operating instructions*.

   Contractor shall provide customer with a comprehensive owner's manual for the system, including detailed operation and maintenance instructions to help ensure effective and persistent system operation.

4. *Monitoring/maintenance instructions per [UTILITY NAME] specifications are plainly mounted/displayed*.

   Monitoring and maintenance instructions, as approved by [UTILITY NAME] for each SPH type, shall be mounted in a plainly visible location near the pool mechanical equipment. These instructions shall clearly include:
   a. How to monitor system performance.
   b. Description and recommended frequency of maintenance.
   c. Diagram of system noting location of valves and monitoring devices.
   d. How to drain the system to prevent freezing in winter.
   e. What to do and who to call in an emergency and when the system needs maintenance or repairs.

## B. Auxiliary Pool Heater

1. *Auxiliary pool heater is electric.*

   The auxiliary pool heater shall be electric.

## C. Equipment and Installation

### General

1. *The swimming pool is equipped with a pool cover*.

   The swimming pool shall be equipped with a pool cover that covers the entire pool surface. It is recommended the cover be the clear bubble type to maximize passive solar gains to the pool when the pool is covered during the day. Acceptable alternatives are insulating foam sheet-type or rubberized canvas covers.

2. *All solar system components are new (not used).*

   To ensure customer's warranty protection for the equipment and installation and to ensure system reliability and performance, only new system components and materials shall be utilized.

3. *System operates properly*.

   System shall be fully operational according to its design.

4. *All system components are covered for protection from the weather.*

   To ensure adequate protection from the weather, all related system components (excluding collectors and piping) shall be covered. If feasible, it is recommended the components be located in a totally enclosed space.

5. *All system components are located to allow access and are adequately protected*.

   To allow room for servicing and/or replacement the installation shall be configured to provide ample access to all parts and components of the system, and protected from incidental damage.

6. *Monitoring devices are installed to be easily visible*.

   All monitoring gauges and valves in the system must be installed to allow easy access to determine that system is functioning correctly.

7. *Any building insulation (attic, floor, wall), disturbed due to system installation, is restored to previous condition.*

   To preserve pre-existing building insulation levels, contractor shall re-fluff, replace, or re-attach in a workmanlike manner, any existing insulation and its support that was disturbed during system installation. The contractor shall document any pre-existing or other damage, not due to the solar installation, by photograph(s) submitted to both the customer and [UTILITY NAME].

## Freeze Protection

8. *BONNEVILLE approved freeze protection is provided*.

   Freeze protection, as approved by BONNEVILLE during qualification of each system type, shall be incorporated.

9. *System is equipped with valves to facilitate a manual draining of the collectors and pipes prior to freezing weather conditions.*

   To protect the solar collectors and collector piping from freezing during winter conditions, valves shall be installed to facilitate a manual draining of the collectors and pipes prior to freezing weather conditions.

## Collector Location, Orientation, Mounting and Plumbing

10. *Collector location has PSF of 0.85 or better, as calculated from lowest edge of the collector(s), or PSF of .60 or better if ALL shading exists below the Mar 21 - Sep 21 sun line on the BONNEVILLE sunchart.*

    The location of solar collectors shall have adequate exposure to sunlight. The collector location must have the minimum Prime Solar Fraction (PSF) of .85 or better within the solar window of 8:00 a.m. to 4:00 p.m., as calculated from the middle of the lowest edge of the collector(s). This shall be determined by the contractor by completing an BONNEVILLE sunchart prior to installation and verified by [UTILITY NAME] at the time of inspection. Alternatively, the collector location may have a PSF of .60 or better if ALL shading exists below the Mar 21 - Sep 21 sun line on the BONNEVILLE sunchart.

11. *Collectors are oriented 40 degrees E or W of due south with a tilt angle of 10 to 35 degrees; or 41 to 90 degrees W, roof pitch of 4/12 or less, and with a tilt angle of 10 to 20 degrees*.

    To ensure adequate exposure to average incident solar radiation, the solar collectors must be oriented within 40 degrees E or W of due south with a tilt angle of 10 to 35 degrees; or within 41 to 90 degrees W on a roof with a pitch of 4/12 or less, and with a tilt angle of 10 to 20 degrees, or, if multiple banks of collectors, a combination of these orientations and tilts. East facing collectors shall not be considered acceptable.

12. *Collectors are pitched a minimum of 1/8 inch per foot to inlet and piping is continuously pitched between collectors and drain valves a minimum 1/8 inch per foot.*

    To allow the fluid to completely drain from the collectors and piping exposed to freezing conditions, the collectors shall be pitched a minimum 1/8 inch per foot to the inlet and piping shall be pitched between collectors and drain valves a minimum 1/8 inch per foot.

13. *Collector rows are plumbed to allow pool water to enter a lower corner and exit the opposite upper corner of each row and the water flows in proper direction.*

    To facilitate optimal solar heating, each row of solar collectors shall be plumbed to cause the pool water to flow diagonally upward through the collectors, i.e., the water enters a lower corner of the row of collectors and exits from the opposite upper corner of the row of collectors to the pool.

14. *All rows of collectors are plumbed in parallel and the plumbing from all the individual rows of collectors returns to the highest point before the final return to the pool.*

    To ensure all collectors in the system receive a proportionate share of water volume and flow rate thereby producing optimal solar heating, the rows of collectors shall be plumbed in parallel and a "high point of return" shall be provided among rows of collectors.

15. *Multiple rows of collectors, with dissimilar numbers of collectors in each row, are plumbed with balancing valves on the inlet piping and thermometers on the outlet plumbing and the system flow rate is balanced.*

    To facilitate optimal solar heating, all unbalanced rows of collectors shall have a balancing valve on the inlet piping and a thermometer on the outlet piping to allow manual balancing of the system's flow rate. The system's flow rate shall be balanced.

16. *Collector mounting is per manufacturer's specifications*.

    To comply with warranty provision and ensure long-term integrity of the system, collectors shall be mounted according to manufacturer's specifications and any BONNEVILLE requirements specific to the system.

17. *Framework will resist deterioration.*

    To maintain structural integrity of the support system and the collectors, all mounting components, racking materials, and collector framework shall resist deterioration. Wood shall be pressure treated and steel shall be primed and painted to prevent rust. Joiners and fasteners shall be of similar, non-reactive metals of adequate strength.

18. *Corrosion between dissimilar metals has been avoided in all structural components and mounting hardware.*

    Like or compatible metals shall be used to prevent corrosion between dissimilar metals.

19. *Collectors that use a protruding flange connection at the headers shall have flashing installed between each flange and roof surface.*

    To prevent deterioration of the roof surface during expansion and contraction of the collectors, flashing shall be properly installed between each header joint connection and the roof surface.

20. *All roof penetrations are permanently sealed*.

To prevent roof damage and water leaks, all roof penetrations shall be permanently sealed. Pipes shall be run through properly installed roof flanges. Lag screw and spanner bolt penetrations shall be sealed with silicone sealant in and around the holes.

21. *Collectors have 3 hold-down straps across the width of each collector.*

To prevent uplift due to high winds and to ensure collector array stability, all collectors shall have 3 hold-down straps, as supplied by the collector manufacturer, installed across and secured between each collector. Follow these distance requirements between straps as measured from collector top to bottom:

| Collector size | to 1st strap | to 2nd strap | to 3rd strap |
|---|---|---|---|
| 12' | 40" | 84" | 128" |
| 10' | 32" | 68" | 104" |
| 8' | 28" | 54" | 80" |

## System Plumbing/Piping

22. *Piping between collectors and the pool mechanical system is schedule 40 PVC material and is a minimum diameter 1.5" up to 40 gallons/minute and 2" up to 80 gallons/minute.*

To reduce friction losses in the plumbing, minimize the load on the pool pump and achieve adequate system flow, the piping between the collectors and the pool mechanical system shall be schedule 40 PVC material and is a minimum diameter 1.5" up to 40 gallons/minute and 2" up to 80 gallons/minute.

23. *System flow rate is compatible with total number and size of collector panels.*

To achieve optimum solar heating results, the collector panels shall have adequate flow rate through each panel. Follow these flow rate requirements:

| Collector size | Nominal rate in gpm | Minimum rate in gpm |
|---|---|---|
| 12' | 5.0 | 3.0 |
| 10' | 4.0 | 2.5 |
| 8' | 3.25 | 2.0 |

Maximum flow rate is 8 gpm per panel.

24. *Piping runs are adequately supported*.

    To ensure correct system operation and to prevent damage due to trapped pool water in the pipes, piping runs shall be well supported using appropriate materials.

25. *Dielectric unions are used between dissimilar metals*.

    To prevent corrosion and fluid leaks, dielectric unions shall be used between any metallic plumbing components made of dissimilar metals.

26. *There are no leaks in the system plumbing.*

    All plumbing and connections are installed properly to ensure no fluid leakage in the system.

**Valves, Controls, and Meters**

27. *Isolation ball valve and check valve are installed, enabling bypass of solar system.*

    To ensure the system can be isolated from the backup pool heater in an emergency or for servicing the system, a ball valve is installed in the collector supply piping and a check valve is installed in the collector return piping, to enable bypass of the entire solar system.

28. *Drain valves are installed at the lowest point in the system on the collector inlet and outlet piping.*

    To ensure complete system drainage of pool water in the collectors and piping prior to freezing conditions, a manual drain valve shall be installed on both the inlet and outlet piping to the collectors and located at the lowest point in the system.

29. *Vacuum relief valve is installed on the upper collector header for each row of collectors.*

    To allow the water in the collectors to return to the pool when the motorized valve has diverted the flow past the collector array, a vacuum relief valve shall be installed at the upper collector header (opposite the collector outlet) for each row of collectors. This will allow a break of vacuum for the gravity return of the water.

30. *System is equipped with a motorized three-way valve installed in the supply piping to the pool after the pool filter, powered by a differential temperature controller.*

    To maximize efficiency of the pool heating system, a motorized three-way valve powered by a differential temperature controller, shall be installed. This will allow the solar system to be operated only when the panels have available heated water to add to the pool and avoid cooling of the pool during periods of insufficient sun. To ensure proper operation and drainage of the collectors and piping, the 3-way valve shall be installed on the supply piping to the pool, after the pool filter.

31. *Controller is set for desired pool temperature, mounted within 6 ft. of the pool mechanical equipment and is hard-wired or plugged into nearest outlet with the wiring securely attached. If plugged into an outlet, the plug is labeled per BONNEVILLE specifications.*

    To ensure correct system operation the differential control shall be set for the desired pool temperature high-limit. To allow for monitoring and diagnostic servicing of the system, the control shall be mounted within 6 ft. of the motorized 3-way valve, hard-wired or plugged into nearest outlet with the wiring securely attached to parts of the system or adjacent walls or ceiling. If the control is plugged into an outlet, the plug is labeled per BONNEVILLE specifications.

32. *Sensors are placed correctly and attached securely.*

    To ensure accurate operation of the automatic controls, sensors shall be placed correctly and attached securely.

33. *Sensor wiring has good connections and is protected from weather and high temperatures.*

    To ensure correct system operation, the sensor wiring connections shall be permanently joined using crimp-type connectors and then sealed with silicone. The wire shall not come in contact with hot piping or metals, shall be rated for exterior use and be protected (as much as possible) from weather and high temperatures.

34. *Flow meter is provided*.

    To monitor the water flow rate in the system, a flow meter is present in the system piping in an easily visible location.

35. *A thermometer is installed in the return line from the collectors and prior to the auxiliary pool heater.*

    To monitor the temperature of the solar pre-heated water, a thermometer shall be installed between the solar collectors and the auxiliary pool heater.

36. *All valves, gauges and instruments are labeled per BONNEVILLE specifications.*

    To identify and describe the purpose and operation of specific devices in the system, all valves, gauges, and instruments near the pool mechanical equipment shall be labeled. Permanent tags shall be used incorporating BONNEVILLE approved descriptions that include the following:
    a. Name/identification of the valve, gauge, or instrument.
    b. Purpose of the valve, gauge, or instrument.
    c. Operation of the valve, gauge, or instrument.

## REFERENCES


$ Solar Pool Heating, by Michael Fitzgerald (California Solar Energy Industries Assn.)

X Swimming Pool Solar Heating Systems Installation Manual, Aquasol (Division of Solar Depot, San Rafael, CA)